United States
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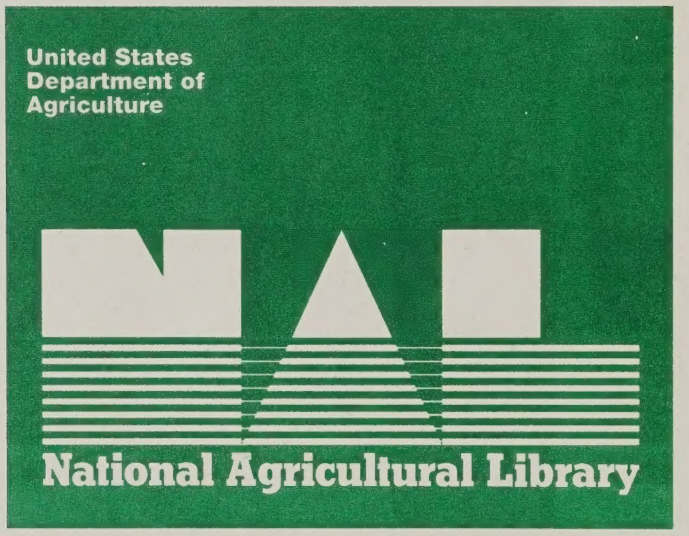
Animal and
Plant Health
Inspection
Service

Plant Protection
and Quarantine

An Analysis of the Mediterranean Fruit Fly Eradication Program in California, 1980-82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Charles Poucher, Florida Department of Agriculture and Consumer Services, who was involved in the 1956 Medfly program in Florida and served on the Technical Committee which provided advice to program managers in the 1980-82 program.

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Edward F. Knipling, U.S. Department of Agriculture (USDA), Agricultural Research Service (ARS), retired consultant, who developed the Sterile Insect Technique (SIT) and served on the Technical Committee.

Edward J. Stubbs, USDA, Animal and Plant Health Inspection Service (APHIS), who was in charge of regulatory activities on the 1980-82 program, and currently is Area Director, APHIS, Guatemala City, Guatemala.

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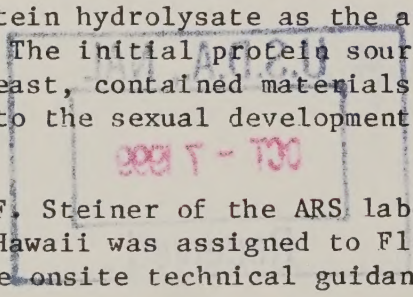
James R. Brazzel, APHIS, in charge of applied research on fruit flies served on the Technical Committee for the 1980-82 program.

Prepared by G. Gregor Rohwer, Assistant Deputy Administrator, Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U.S. Department of Agriculture.

Mediterranean fruit fly (Medfly) invasions of the mainland United States are not new. The first, in 1929, was introduced into a predominantly rural area in central Florida. This invasion occurred before effective male attractants or insecticide/bait sprays were available and was eventually eradicated after a long fight by use of host destruction in combination with pesticides. At the time there were no effective treatment procedures to allow pest-free movement of host fruits from regulated areas. Federal-State costs of this campaign were approximately $7 million (equivalent to about $37 million in 1981 dollars).

The second infestation (1956) also occurred in Florida but was introduced into the city of Miami. It had spread to central Florida before eradication efforts could be successfully mounted. Fortunately, there was preliminary information at the Agricultural Research Service (ARS) laboratory in Hawaii that an insecticide/bait spray was effective in control and that a possible male attractant had been found. The promising bait spray consisted of a mixture of wettable malathion in water combined with a protein hydrolysate as the attractant. The initial protein source, brewer's yeast, contained materials essential to the sexual development of the fly.



Dr. Loren F. Steiner of the ARS laboratory in Hawaii was assigned to Florida to give onsite technical guidance to the program; and the author, an employee of the Animal and Plant Health Inspection Service (APHIS), was placed in charge of field operations. A trap, later referred to as the Steiner trap, was developed onsite during this campaign initially by utilizing oil of angelica seed to attract males. Also, onsite field tests proved that the promising bait sprays were effective when applied by aircraft. Fortunately, fumigation and other treatment procedures had been developed so that most of the host products could be moved from the infested area on the basis of treatment. This invasion was eradicated at a cost of approximately $12 million in Federal-State funds (about $40 million in 1981 terms).

Following those major infestations, incipient minor invasions were detected in metropolitan areas in Florida, Texas, and California. By then an early detection trapping program was in operation, using a male attractant, that made it possible to immediately detect incipient infestations and apply bait sprays to eradicate the infestations. California invasions in 1975-76 (Los Angeles) and 1980 (Los Angeles and San Jose) also were introduced into metropolitan areas. Although I was not directly involved in the 1980 California program until a decision was made to apply aerial bait sprays, records of activities conducted there were available to me to serve as a basis for this analysis.

General Problems

Only one of the numerous Medfly invasions of the mainland United States was introduced into a rural area (Florida 1929). Medfly outbreaks in urban areas prior to the most recent California invasion had been eradicated before the public became seriously concerned regarding the widespread use of pesticides.

Public concern was of a general nature in the California invasion of 1980 and had been aggravated by publication in the news media of inaccurate statements regarding the effects of pesticides and their hazards as they were to be applied. As the 1980 California invasions were introduced into densely populated areas, public concern with the use of pesticides had a tremendous impact on eradication technologies initially selected. Because it was considered as a sociopolitical problem, even the Governor of California was involved in the decisionmaking process.

Another problem that affected the outcome of the program, particularly as to technologies utilized, was a scientific misjudgment regarding the expected ecological range of the Medfly. Although scientists agreed that the Medfly could overwinter in southern California, some mistakenly believed it could not overwinter in central California. 1/ Certain that it would die out anyway in the colder months, they felt it posed no threat and thus required no further controls.

The third important difficulty encountered was a technological problem relative to the use of sterile insects. When sterile insects are released, the ratio of wild flies to released sterile should be known to determine when sufficient overflooding ratios have been achieved. A technology had been developed to distinguish between dyed sterile insects and wild flies, but it was laborious and time consuming. To reduce resource requirements, the decision was made to try a different, more rapid sorting procedure. The sterile fly program and the effect of this rapid sorting procedure are discussed later.

1/ This position was based on an inaccurate interpretation of growth chamber studies.

1980 Los Angeles Infestation

Two introductions occurred in Los Angeles during the most recent Medfly invasion. The first, detected on June 5, 1980, was eradicated that year. The second, in a different area, was detected on August 25, 1981. It is believed the latter invasion was a result of infested host product movement from the Santa Clara Valley of central California. Before the 1980 finds, officials of Los Angeles County had maintained an effective fruit fly detection program throughout the year. When the first fly was found June 5, 1980, it was immediately identified; and prompt action was taken to eradicate the infestation. Bait sprays were applied promptly and sterile insects were obtained from the ARS laboratory in Hawaii as soon as possible.

It is important to note that the limits of this small infestation were delineated initially by an extremely high-quality and effective year-round trapping program. Additional traps also were installed immediately after detection to accurately determine the extent and degree of the infestation. Therefore, the use of ground bait sprays supplemented by the release of sterile flies made it possible to eradicate the infestation quickly. The last Medfly was found in this area on June 14, 1980. A total of only four wild spec-

imens were recovered in the 1980 infestation, and over 205.61 million sterile insects were released in the area (table 1).

The second infestation in Los Angeles, found on August 25, 1981, will be reviewed later in connection with the general infestation in the Santa Clara Valley, which spread to other counties, including Los Angeles, before it was eradicated.

Central California (Santa Clara Valley) Sterile Insect Technique (SIT) Program

Detection traps were routinely removed during the winter in the Santa Clara Valley area because many officials did not believe the fly could overwinter. Traps were placed in the field in the spring of 1980 and two flies were found in the first trap tending on June 5, 1980. Unfortunately, they were not identified until 2 weeks later, which indicated the general lack of concern about Medfly in that area. The delay in identification adversely impacted on the prompt initiation of any other program activity. Based on a review of additional trap catches and larval finds, it was concluded by those who worked on or analyzed the program that the infestation detected on June 5, 1980, undoubtedly had resulted from an overwintering population. In addition, the trapping program in that area was not conducted in a manner to promptly detect and delimit infestations. Information was not available regarding the extent of the infestation or the population level.

In spite of these deficiencies, a decision was made to utilize the Sterile Insect Technique (SIT) approach to eradication in the Santa Clara Valley that had been used in 1980 in Los Angeles. Ground bait sprays were not applied immediately after pest discovery but were used only with the permission of property owners. Even after bait spray treatments got underway, spray crews could not keep up with the infestations as promptly as they were detected.

As indicated in table 1, sterile releases were initiated in Santa Clara County on July 14, 1980, more than a month after the June 5 detection. At that time of the year one life cycle of Medfly could be expected per month. As previously indicated, it is believed the June 5 Santa Clara find represented a 1979-80 overwintering infestation. Therefore, an infestation of unknown size and density undoubtedly was reproducing before controls were initiated. In addition to the delay in applying effective pesticide treatment, problems also arose with the quality of the sterile flies obtained from several different rearing operations. Since there was no standby production facility for Medfly in the United States, flies were initially obtained from the ARS research facility in Hawaii. Later, sterile flies were purchased from Costa Rica, Peru, and Mexico, and the State of California developed a fly production facility in Hawaii.

A total of 4,139.79 million steriles were released in central California in the counties of Alameda, San Mateo, and Santa Clara (table 1). Twenty-six mated females were detected in male attractant traps from October 1980 through June 1981 (table 2). Of particular significance is the finding of 15 mated females from April through June 1981 when the SIT program had been in operation over 8 months. This indicated problems with the entire control program. As stated, there were problems with the ground bait sprays, with the quality and timeliness of sterile insect releases, and possibly with the ratio of steriles to wild flies due to insufficient trapping information to indicate locations and

population levels of wild flies.

Another problem alluded to earlier was the December 1980 change in laboratory techniques to separate released steriles from wild flies. When steriles finally were received in large quantities, manpower problems were encountered in the laboratory when using the technique employed in Los Angeles to separate natives from steriles. It should be emphasized, however, that wild flies continued to be detected in the Santa Clara Valley prior to the change in identification procedures, as well as following that change. Table 2 summarizes by month total fly captures throughout the program. Adult flies were captured during all winter months (1980-81) except February. After the December 1980 change in laboratory procedures, no wild male flies were identified (although a male attractant was used in the traps) until mid-June when the sterile release program was discontinued and aerial bait sprays were initiated.

Based on field experience with Medfly invasions since 1956, it is not unusual to trap limited numbers of females particularly when an infestation is first becoming established and/or populations are low. This is well depicted in table 3, which summarizes by county male and female flies trapped during the entire program. The ratio of male to female is 266 to 135 or about 2 males for every female. However, if we discount the number of females trapped in January 1981 through June 1981 (the period when laboratory identification problems were involved, before aerial sprays were initiated and sterile drops were discontinued) the ratio of males to females is 266 to 88 or about 3 males to 1 female (table 4). If we discount all specimens trapped before aerial bait sprays were initiated, thereby eliminating any laboratory problems involved in separating steriles from natives, the ratio becomes 138 males to 15 females or over 9 to 1 (table 5). The latter figure is more closely related to what is expected in sex ratios based on the use of the male attractant for newly introduced populations in the mainland United States. This also approximates the ratio reported on new populations in south Mexico.

In the 1956-57 Florida eradication program, the phenomenon of trapping females in male attractants traps was first demonstrated in the field. After trapping limited numbers of females, discussions were held with Dr. L. F. Steiner, the research advisor, who indicated that this result could be expected in lightly infested areas and further that sexually immature flies would be more frequently collected. Unfortunately data are no longer available from the 1956 program. To the best of my memory and that of Charles Poucher, who also worked on the 1956 program, the sex ratio was greater than 3 males to 1 female. During the period when laboratory identification problems were encountered (January 1981 through June 1981) 48 females were identified (table 2). With a sex ratio of only 2 to 1, 96 males were discarded during that period; 3 to 1 ratio - 144 males; and 9 to 1 ratio - 432 males. This indicates a sizable overwintering population which would serve as a basis for a population explosion when favored hosts (apricots) and temperature conditions became optimal.

Based on fly catches from October 1980 through April 1981, when 23 males, 16 mated females, and 47 unmated females were collected, it is obvious that there was a sizable overwintering infestation in the Santa Clara Valley in 1980-81 (table 2). This population of natives was sufficient to account for the outbreak conditions that occurred when the highly preferred apricot hosts

were ripening in the Santa Clara Valley in June 1981. Apricots are abundant in the residential areas where they were commercially produced prior to residential development. A similar flareup in Medfly was observed in the Homestead, Florida, area in 1956 when backyard peaches were fruiting. Shortly before that time no flies had been trapped in Homestead.

The Medfly project laboratory routinely examined trapped wild Medfly females for the presence of eggs. The laboratory also made routine quality control checks of sterile insects received from all production facilities. A female fly containing yellow dye, indicating its origin was the Peru sterile insect production facility, was found to contain eggs. This fly was believed to be from a batch released in June 1981. This finding indicated a potential problem with production facilities, and it was suggested that the Medfly population flareup in 1981 may have been caused by nonsterilized released insects. The laboratory conducted an intensive study and examined over 7,000 additional females which it was holding under refrigeration. A few eggs were detected in a limited number of additional flies--another from Peru, and two each from the production facility in Mexico and the California-operated facility in Hawaii.

Although this finding may have accentuated the already existing problems of the overwintering native populations in the Santa Clara Valley, it was not, in the author's opinion, responsible for the Medfly flareup in June. This conclusion is based on (1) the number of overwintering trapped native flies, (2) the small number of "nonsterile" flies detected in the California quality control laboratory from all sterile fly production sources, and (3) field observations beginning in 1956 on the explosive potential of the Medfly from low populations (as indicated by trap recoveries) when environmental conditions become optimal (highly preferred hosts and favorable temperature conditions).

It is concluded that the SIT program in central California failed for two reasons: (1) The limits and degree of infestation were not determined by the trapping program, and (2) There were insufficient high-quality steriles available in time to combat the infestation. A contributing factor was that the selective bait sprays applied by ground equipment were not adequate to prevent spread or to maintain populations at a low enough level for the sterile insects to eradicate the infestation. According to supervisors on the program at that time, ground--applied bait sprays never covered more than 25 percent of the known infested area.

Although the problem-plagued SIT/bait spray program in effect from June 1980 until July 14, 1981, did not eradicate the Medfly, it did suppress populations. If those combined treatments had not been applied, the Medfly undoubtedly would have spread throughout a large portion of its ecological range in California by the summer of 1981.

Legal/Administrative Problems

Due to continuing Medfly detections into the 1980-81 winter, attempts were made to initiate an aerially applied bait spray program. Many meetings were held with city, county, and State officials proposing such an aerial bait spray program to eradicate the infestation. County and city officials and the public were opposed to the aerial application of bait sprays. State officials decided that the program would be continued using sterile insects and bait sprays applied by ground equipment, with increased emphasis on strip-

ping certain host fruits.

At that time, only the State had the right of entry on private property to apply pesticides. The Federal Government had no authority to apply aerial sprays except on Federal property. Due to continuing detections of Medfly in the 1980-81 winter and the increased number of finds in the spring of 1981, many State officials became dissatisfied with the eradication effort. Several States challenged the Federal Government's quarantine authority and invoked regulations to protect themselves from the movement of California host products. The States were dissatisfied with the continued extension of regulated areas by the Federal Government, which indicated to them that the infestation was out of hand. A number of States placed quarantines against California that were more restrictive than those of the Federal regulations.

The Federal Government challenged State actions in court in Texas, indicating that Federal quarantine law preempted States from taking more restrictive action. Although the Federal preemption authority was upheld, the States had made their point, indicating their dissatisfaction with the program.

Also, some foreign governments, particularly Japan, became more concerned about the possible movement of Medly-infested products into their country and placed tighter restrictions on the import of agricultural products from the United States. These restrictions had a serious impact on the agricultural economy, especially in California where agricultural officials estimated the industry lost at least $100 million.

In spite of these problems, the public was still opposed to the use of aerially applied bait sprays. It was not until the U.S. Secretary of Agriculture advised California that he had no alternative but to regulate the entire State that serious consideration was given to aerially applied bait sprays. The State agreed in early July, but was immediately challenged in court. Although the decision was upheld, the aerial bait spray program could not get underway until mid-July.

California Aerial Bait Spray Program

The aerially applied bait spray consisted of 2.4 ounces of technical malathion (91 percent) mixed with 9.6 ounces of a corn protein hydrolysate per acre. The corn protein hydrolysate, a byproduct of corn manufacturing, contains ingredients necessary for the fruit fly to become sexually mature. Aircraft applied 12 fluid ounces of insecticide/bait per acre at weekly intervals. Helicopters applied the material at night over densely populated areas and fixed-wing aircraft were used elsewhere.

Application intervals of the bait sprays spanned two life cycles after the last fly find, as determined by trapping or larval recoveries. Based on research work in Hawaii and previous experience with eradication programs in the United States, it was anticipated that an average life cycle under optimum weather conditions was about 30 days. Thirty days, with an adjustment for winter temperatures, was used in all previous programs as a basis for discontinuing treatments and removing quarantine regulations.

In the California program, however, a day degree temperature model, developed by Richard Tassan of the University of California, was used, coupled with judgments based on an analysis of each infested area. Thermometers were placed in the soil at the depth where larvae would pupate, and air temperatures were taken to determine the ex-

pected life cycle. This procedure more clearly defined the Medfly's expected life cycle under varying climatic conditions in the various ecological niches in which fruit flies had been detected. Although the Tassan model may be improved, it was beneficial in determining the length of spray treatments and regulatory controls needed under California conditions.

Table 6 summarizes by county the aerially applied bait sprays. The actual land area under treatment at one time represented 1,496 square miles, with accumulated treatments accounting for 16,601 square miles.

In San Benito County, where only one fly was detected, sprays were applied promptly and completed in 72 days (two life cycles). If the detection program is conducted in an efficient manner and aerial bait sprays are applied immediately after detection, it is not unusual to find only a single fly or, at most, a very limited number of specimens after the initiation of aerial bait sprays. That was the case in San Benito County.

In San Joaquin County, the only location where a fly was found in 1982 and controls applied, sprays were applied for only 49 days. Normally a single fly find would not be treated except under situations where general and expanding infestations are found. The decision to spray for one fly generation was based on previously mentioned program problems and the desire to assure eradication.

Table 7 shows the effectiveness of aerial bait sprays. It tabulates by county all fly recoveries after the initiation of aerial bait sprays on July 14, 1981. In Alameda, Santa Clara, and San Mateo counties, even though infestations were known to occur since 1980, a total of only 14 male and 12 female flies were trapped after aerial bait sprays were initiated. Of the nine males in Santa Clara, one was taken from a trap on July 14. Aerial sprays were started about midnight of July 14; therefore, the fly probably was in the trap before spraying started. Difficulties with the aircraft spray pumps on July 14 and 15 affected the amount of area treated as well as spray coverage.

The Medfly becomes sexually mature about 4 days after its emergence under favorable conditions. Thus the effectiveness of aerial bait sprays is demonstrated by the recovery of only 3 mated females versus 12 unmated females after July 14. Of the three mated females, the one in Santa Cruz County represented a new find where sprays had not been applied, and the two in Santa Clara County were recovered outside previously established spray boundary lines. When flies were found outside spray boundaries, changes in spray areas were made promptly. Fly finds after aerial sprays were started in each county are shown in table 8. These data further substantiate the effectiveness of aerially applied bait sprays. In Los Angeles County, nine male flies were trapped in August 1981 before aerial sprays were initiated. Because of very hot weather at the time of the initial treatment and air inversion, much of the spray evaporated and coverage was poor. In addition, the seven male flies found in October were trapped outside the previously established spray boundary.

In Santa Cruz County, the first detection was a mated female and spraying was initiated. Two additional flies were trapped, both of which were outside the previously defined spray area.

In Stanislaus County, 60 male flies were detected in mid-August before the initiation of aerial sprays. Following bait spray treatments, only four flies

were detected, the last on September 3.

In summary, the bait spray treatments were initiated July 14, 1981, and extended through August 12, 1982. The maximum number of days (344) any county was under treatment (Santa Clara) was due to a combination of factors, including the extent to which infestations had become established (area and intensity); recoveries outside established spray boundaries; problems encountered in spray application; and more importantly, the extended life cycle under various ecological or climatological niches where flies were recovered based on the Tassan day/degree model.

Regulated Areas

An agreement of long standing with State officials in the United States for pest eradication to be declared is that geographical areas will be subject to regulation until a minimum of three negative life cycles have elapsed. For Medfly, the number of negative life cycles is based on trap finds or recovery of any immature forms. These findings are correlated with the day degree temperature model which predicts the length of the life cycle. Table 9 shows by county the first and last Medfly find and the time when quarantine regulations were invoked. Four counties (Alameda, Santa Clara, Santa Cruz, and San Mateo) were entirely regulated because of the extent of infestation in central California. The minimum area placed under regulation for single finds is 91 square miles as shown for San Joaquin County. Table 9 shows a total of 4,157.5 square miles were regulated in California.

Because of the impact of cool winter temperatures, particularly in certain areas in central California, the life cycle was extended based on the Tassan model referred to earlier. In San Benito County, treatments were completed in 72 days, but 202 days were required before the area was considered free of Medfly and regulations removed. This judgment was influenced to some degree by the location of the San Benito detection, which was in close proximity to the general infestation in Santa Clara County.

Costs

Approximately $100 million of Federal-State funds were spent in eradicating the infestations in California. In addition to the direct outlay of Federal and State expenditures, it was estimated by California agricultural officials, as stated earlier, that the infestations cost the agricultural industry about $100 million in lost markets.

It probably would have cost the Federal and State Governments about $20 million to eradicate the infestations had it not been for the sociopolitical problems and scientific-technological mistakes. Regardless of these costs, estimates have been made that should the Medfly be allowed to enter and spread throughout its ecological range within the United States, average annual losses could reach $250 to $500 million.

Positive Results/Actions/Benefits

When the California outbreak occurred, authority for right-of-entry to private property to combat infestations rested with State governments. As a result of the problems encountered, a Congressman from California introduced legislation to authorize the Federal Government under emergency conditions to enter private property to combat pest outbreaks and apply regulatory authority over movements of products within a State. The U.S Congress approved this proposal; however, as a matter of policy, the U.S. Department of Agriculture prefers not to utilize this authority un-

less necessary.

Another benefit resulting from the problems encountered in California is the increased emphasis placed on development of pesticide assessment information. Pesticide assessments had been initiated prior to the California outbreak because of difficulties in dealing with the public. This program consists of (1) developing a protocol for assessing the effect(s) of a pesticide on nontarget organisms, including people; (2) developing an actual assessment for selected pesticides based on use patterns, methods of application, and so on; (3) training action program personnel (State and Federal) to thoroughly understand the material and how it was developed so they can better deal with the public; and (4) providing for a toxicologist to be available to meet with public groups in the event that State or Federal action program personnel are not able to answer questions satisfactorily. Unfortunately, the program was in the developmental stage and information was not available for use by the California Medfly program. It has been used since then to a limited extent on other programs and has proved to be very beneficial. Public relations should improve with its wider application.

As indicated, there was considerable disagreement about procedures to use in combating Medfly invasions. This disagreement led to the development of planned courses of action known as "action plans." Action plans set forth methodologies for combating a pest invasion in the United States. As feasible, they are developed in advance of pest introduction. State and Federal research agencies, the affected agricultural industry, and State and Fedderal action personnel work together in reviewing all available information. They agree and document procedures to be utilized to combat a pest under different pest outbreak situations. An action plan has been developed for Medfly. Should another outbreak occur in the United States, it is hoped the action plan developed to eradicate the pest will be initiated.

Plant Protection and Quarantine (PPQ), APHIS, also is continuing to support the training of an emergency cadre of personnel. This cadre is trained in all aspects of pest eradication-control programs so that they may be called on at a moments notice to deal with pest outbreak situations.

Experiences on the California Medfly Program emphasized the recognized need to increase PPQ liaison activities with foreign governments. The first approach was with Japan because of the importance of the agricultural export market to that country. Annual meetings have been held with Japanese officials to exchange technical information. Other exchanges include information relating to quarantine philosophy, treatment procedures, and so on. These exchanges are being expanded to include other countries.

There is increasing emphasis on the need to develop adequate scientific information. Plans have been developed to obtain more information on trap efficacy and procedures to utilize in marking steriles. An International Medfly Work Group has been formed. The initial group consisted of representatives of action program personnel in Guatemala, Mexico, and the United States, because cooperative Medfly activities are being conducted in all three countries. In addition to action program personnel, there are representatives from research groups in the States, APHIS and other Federal agencies, and a representative from the International Atomic Energy Agency. There have been two meetings of this International Medfly Work Group, at

which time research needs were identified, priorities set, and agreement reached as to the responsible agency to conduct the research and the supporting agencies. This group is to be expanded to include other countries that have or plan action programs to combat the Medfly.

Increased emphasis also has been given to the need for a backup rearing facility to better utilize SIT. Such a backup rearing facility for fruit flies is to be constructed in Hawaii.

Summary

Based on field experience with the Medfly from 1956 through 1982 in Florida, Costa Rica, Nicaragua, Guatemala, Mexico, and California, it is the author's opinion that the failure of SIT to eradicate the central California infesinfestation was due to logistical problems and not to inadequacies in the SIT concept. The 1981 flare up of infestation in the Santa Clara Valley was due to 1980-81 overwintering populations of Medfly. The magnitude of the population was not indicated by the trapping program as it was conducted. Also, a change in laboratory technology to separate steriles from natives, begun in December 1980, resulted in discarding native male flies because they were confused with steriles. Native female flies were recorded for every month except February 1981. The flare up occurred after sizable trap catches in April in the presence of highly preferred hosts, including apricots. Even though the native population could have been augmented through the release of a limited number of nonsterilized insects from sterile production laboratories, overwintering populations were sufficient for the flareup to occur with or without any such augmentation. Such population explosions were witnessed in building populations in Florida in 1956 and in Central America and Mexico.

SIT problems in California indicate the extreme urgency of designing better techniques to separate steriles from native insects. Until such new techniques are developed, however, sufficient manpower must be committed to effective utilize procedures already demonstrated to be successful elsewhere.

Table 1. Sterile Medfly Releases

County	Releases		Total Flies Released (Millions)
	Initiated	Completed	
Los Angeles	7-14-80	10-18-80	205.61
Santa Clara	7-14-80	7-16-81	3,925.49
Alameda	12-14-80	7-16-81	209.80
San Mateo	6-15-81	7-16-81	4.50
Total			4,345.40

Table 2. Summary of Adult Finds by County

Month	County	1980				1981				1982			
		Males	Females			Males	Females			Males	Females		
			M	U	?		M	U	?		M	U	?
January	Santa Clara							5					
February													
March	Santa Clara							1					
April	Santa Clara						4	20					
	San Mateo						1						
May	Santa Clara						3	5					
June	Los Angeles	2		1									
	Santa Clara	2					5	2					
	Alameda						1						
	San Mateo						1						
	San Joaquin									1			
July	Santa Clara	43	1	11	2	5							
	Los Angeles			1						1*			
August	Santa Clara	40	4	6	1	2	2	5					
	Alameda					2		2					
	Santa Cruz					1	1						
	Stanislaus					63							
	San Benito							1					
	Los Angeles					17							
September	Santa Clara	18	2	10									
	San Mateo			1		1		1					
	Los Angeles					34							
	Alameda					1							
	Stanislaus					1							
October	Santa Clara	17	10	13		2							
	Alameda	1		3				2					
	Los Angeles					7							
	Santa Cruz							1					
November	Santa Clara	3	1	2									
	Alameda	2		1									
	San Mateo					1							
December	Santa Clara			2									
		128	18	51	3	137	18	45		2			

Total Males 267

Total Females 132

M - Mated
U - Unmated
? - Mated Status Not Confirmed

U-36/M-96

* Four adults reported in Los Angeles in 1981 were from field collected larvae reared in laboratory. One very dry male taken from a trap in 1982 believed not to have been associated with previous California infestations and may have been a "plant."

Table 3. Total Wild Medfly Finds in Male Lure Traps During Entire Program

County	1980				1981			1982			Ratio	
	♂	♀			♂	♀		♂	♀		♂	♀
		U	M	?		U	M		U	M		
Alameda	3	4			3	4	1				6	9
Los Angeles	2	2			58						60	2
San Benito						1						1
Santa Clara	123	44	18	3	9	38	14				132	117
Santa Cruz					1	1	1				1	2
San Joaquin								1			1	
San Mateo		1			2	1	2				2	4
Stanislaus					64						64	
Total	128	51	18	3	137	45	18	1			266	135

Table 4. Medfly Finds in ♂ Lure Traps by Sex Omitting ♀ Trapped January-June 1981

County	1980				1981			1982			Ratio	
	♂	♀			♂	♀		♂	♀		♂	♀
		U	M	?		U	M		U	M		
Alameda	3	4			3	4	1				6	9
Los Angeles	2	2			58						60	2
San Benito						1						1
Santa Clara	123	44	18	3	9	5	2				132	72
Santa Cruz					1	1	1				1	2
San Joaquin								1			1	
San Mateo		1			2	1					2	2
Stanislaus					64						64	
Total	128	51	18	3	137	12	4	1			266	88

Table 5. Medfly Finds in ♂ Lure Traps after July 1, 1981

(Areial Spray Program Started July 14, 1981)

County	1981			1982			Ratio	
	♂	♀		♂	♀		♂	♀
		U	M		U	M		
Alameda	3	4					3	4
Los Angeles	58						58	
San Benito		1					0	1
Santa Clara	9	5	2				9	7
Santa Cruz	1	1	1				1	2
San Joaquin				1			1	
San Mateo	2	1					2	1
Stanislaus	64						64	
Total	137	12	3	1			138	15

Table 6. Air Bait Spray Treatments

County	Treatments			Maximum Square Miles
	Initiated	Completed		
Santa Clara	7-14-81	6-22-82	(344 days)	643.7
Alameda	8-15-81	6-8-82	(298 days)	241.2
Stanislaus	8-15-81	3-13-82	(211 days)	99.5
Santa Cruz	8-17-81	6-15-82	(272 days)	77.8
San Benito	8-22-81	11-1-81	(72 days)	285.1
San Mateo	8-24-81	6-29-82	(310 days)	105.7
Los Angeles	8-27-81	4-28-82	(245 days)	36.0
San Joaquin	6-25-82	8-12-82	(49 days)	9.6

Totals:		
	Actual Square Miles	1,495.9
	Actual Acres	957,375.0
	Accumulative Square Miles	16,601.4
	Accumulative Acres	10,624,869.5

Treatment spanned the period July 14, 1981, through August 12, 1982 (395 days).

Table 7. Medfly Finds in ♂ Lure Traps After Aerial Spray Initiation July 14, 1981

County	Month and Total	1981			1982			Total Both Sexes		
		♂	♀		♂	♀				
			U	M		U	M	♂	♀	Total
Alameda	Aug.	2	2			2	2	2	2	4
	Sept.	1						1		1
	Oct.		2						2	2
	Total	3	4					3	4	7
Los Angeles	Aug.	17						17		17
	Sept.	34						34		34
	Oct.	7						7		7
	Total	58						58		58
San Benito	Aug.		1						1	1
	Total		1						1	1
Santa Clara	July	5						5		5
	Aug.	2	5	2				2	7	9
	Oct.	2						2		2
	Total	9	5	2				9	7	16
Santa Cruz	Aug.	1		1				1	1	2
	Oct.		1						1	1
	Total	1	1	1				1	2	3
San Joaquin	June				1			1		1
	Total				1			1		1
San Mateo	Sept.	1	1					1	1	2
	Nov.	1						1		1
	Total	2	1					2	1	3
Stanislaus	Aug.	63						63		63
	Sept.	1						1		1
	Total	64						64		64
Totals After July 14, 1981		137	12	3	1			138	15	153

Table 8. 1981 Medfly Finds in Male Lure Traps after Starting Aerial Sprays in Each Country

County	MONTHS															Total by Country
	July			August			September			October			November			
	♂	♀ U	♀ M	♂	♀ U	♀ M	♂	♀ U	♀ M	♂	♀ U	♀ M	♂	♀ U	♀ M	
Alameda *				2	2		1				2					7
Los Angeles **				8			29			7						44
Santa Clara *	5			2	5	2				2						16
Santa Cruz ***				1							1					2
San Mateo *							1	1					1			3
Stanislaus ****				3			1									4
Total Flies by Month	5			16	7	2	32	1		9	3		1			76

* Aerial Sprays started July 14 due to previous fly finds; 2 mated ♀ in Santa Clara County found outside previously established spray areas.

** 9 ♂ flies trapped August 25 and 26 before sprays started; 1st spray coverage poor due to high temperatures and air inversion; 7 ♂ flies in October outside previously established spray area.

*** 1 mated ♀ detected and sprays started in August; 2 additional flies outside previously established spray area.

**** 60 ♂ flies trapped before sprays started in August.

Table 9. Regulated Areas

County	Recoveries		Federal Regulations		Maximum Regulated (Square Miels)
	First/Stage	Last/Stage	Invoked	Revoked	
Los Angeles	6-05-8Q M	6-14-80 F(U)	7-29-80	12-12-80 (137 days)	130.0
Santa Clara	6-05-80 M	10-29-81 M	7-29-80	9-03-82 (767 days)	1,310.0 (Entire)
Alameda	10-01-81 F(U)	10-08-81 F(U)	12-12-80	7-02-82 (568 days)	743.0 (Entire)
San Mateo	9-04-80* F(U)	11-20-81 M	7-14-81**	9-03-82 (417 days)	454.0 (Entire)
Santa Cruz	8-07-81 F(M)	10-27-81 F(U)	8-19-81	8-06-82 (353-days)	441.0 (Entire)
Stanislaus	8-13-81 M	9-03-81 M	8-19-81	6-01-82 (287 days)	264.0
Los Angeles	8-25-81 M	10-28-81 L	9-02-81	6-01-82 (274 days)	105.0
San Benito	8-20-81 (F(U)		9-02-81	6-01-82 (274 days)	618.0
San Joaquin	6-24-82 M		7-06-82	9-21-82 (78 days)	92.5
Total					4,157.5

* A single specimen, thought to be the result of trap contamination, recorded in 1980.

** Under State quarantine prior to Federal Regulations.

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